CLAIMS

1. An instrument comprising an Inductively Coupled Plasma Source Mass Spectrometer equipped with a multi-dimensional detector system wherein ions transmitted by the mass spectrometer are detected with high selectivity.

2. An instrument according to claim 1 wherein the multi-dimensional detector system comprises a plurality of sub-systems which provide a unitary response.

3. An instrument according to claim 2 wherein the multi-dimensional detector system comprises two sub-systems.

4. An instrument according to claim 3 wherein the sub-systems comprise a specific detector and a non-specific detector.

5. An instrument according to claim 3 wherein the two sub-systems of the multi-dimensional detector system are correlated temporally with high resolution.

6. An instrument according to claim 5 that provides co-incidence detection of transmitted ions.

7. An instrument according to claim 4 wherein the specific detector is based on optical spectrometry.

8. An instrument according to claim 7 wherein the specific detection of the transmitted ions is *via* resonance scattering processes.

9. An instrument according to claim 8 wherein the specific detection of the transmitted ions is *via* laser induced fluorescence.

10. An instrument according to claim 8 provided with means for collecting and detecting resonantly scattered photons efficiently.

11. An instrument according to claim 8 provided with means for the detection of the resonantly scattered photons with high temporal and spatial resolution.

12. An instrument according to claim 11 wherein the detection of resonantly scattered photons is *via* an imaging photomultiplier tube.

13. An instrument according to claim 4 wherein the second detector is a non-specific ion counting device.

14. An instrument according to claim 13 wherein the non-specific ion counting device is an electron multiplier.

15. An instrument according to claim 1 provided with means for manipulating the mean ion energy thereby reducing the relative spread of the ion beams energies.

16. An instrument according to claim 15 wherein the relative spread of ion beam energies may be manipulated to compress the optical bandwidth of the transmitted ions.

17. An instrument according to claim 15 provided with means for accelerating or decelerating the transmitted ion beam to manipulate the average ion beam energy and consequently the relative spread of ion beam energies.

18. An instrument according to claim 1 wherein a front-end collision/reaction cell is used to reduce the spread of the ion beam energies and compress the optical bandwidth of the transmitted ions.

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19. An instrument according to claim 1 provided with means for manipulating the ion beam energies to bring the transmitted ion beam into resonance within the detection volume of the optical detector.

20. An instrument according to claim 19 provided with means for accelerating or decelerating the ion beam.

21. An instrument according to claim 7 wherein the ion beam is accelerated to induce an optical isotope shift by Doppler shifting.

22. An instrument according to claim 1 wherein a multiple exit slit assembly is incorporated.

23. An instrument according to claim 22 wherein the dual detector assembly is mounted upon the multiple slit assembly

24. An instrument according to claim 23 wherein the dual detector assembly is mounted upon the axial exit slit.

25. An instrument according to claim 22 wherein additional non-specific ion detectors are mounted upon the multiple exit slit assembly.

26. An instrument according to claim 25 wherein additional non-specific ion detectors are mounted upon the off-axis exit slits.

27. An instrument according to claim 26 wherein the non-specific ion detectors are electron multiplier devices.

28. A method for detecting and quantifying low concentrations of stable and/or radioisotopes and/or low abundance isotopes which comprises analysing a sample in an instrument according to claim 1.

29. A method according to claim 28 wherein the species being detected is a radionuclide.

30. A method according to claim 28 wherein selectivity is enhanced by specific optical detection of transmitted ions.

31. A method according to claim 28 wherein selectivity is enhanced by specific isotopic selection via optical isotope shifts.

32. A method according to claim 28 wherein selectivity is enhanced by inducing an optical isotope shift by acceleration of the transmitted ions with subsequent Doppler shifting.

33. A method according to claim 28 wherein selectivity is enhanced by optical probing of hyperfine splitting.

34. A method according to claim 28 wherein non-specific background is reduced by co-incidence detection of transmitted ions with subsequent improved detection limit.

35. An instrument substantially as described with reference the accompanying examples and drawings.